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### (54) Terminal multiplexer structure

(57) A terminal multiplexer structure comprising a plurality of line interface cards and a plurality of trunk interface cards wherein each of the line interface cards

is connected to at least two of the trunk interface cards and comprises switching means for switching the connection transmission from the line interface board between the two trunk interface cards.

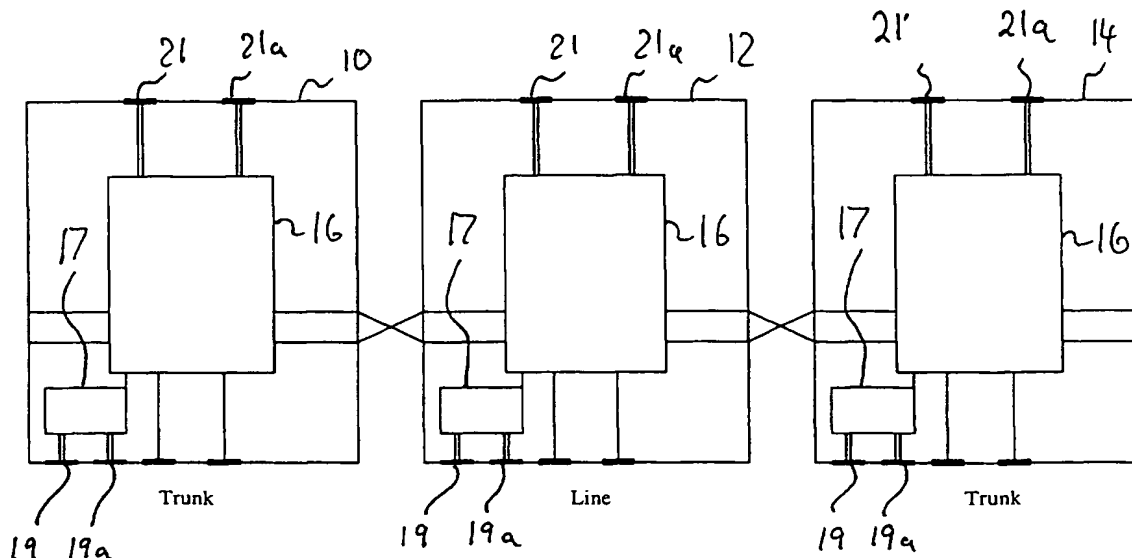


Figure 1

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## Description

### Field of the invention

[0001] The present invention relates to a terminal multiplexer structure for use in a network node system.

### Background of the invention

[0002] There is a need for providing a flexible dense wavelength division multiplexing (DWDM) and switching architecture, eg for use in network node systems.

[0003] Traditional architectures centre around a fixed link between line interfaces and trunk interfaces to channels of the DWDM. Such architectures have the disadvantage that failure of one of the DWDM channels will effectively cut out one of the line connections, ie service to a particular subscriber is disrupted until the faulty DWDM channel has been "repaired", eg by replacing a DWDM laser.

[0004] The present invention seeks to provide a multiplexer structure which addresses this problem.

### Summary of the invention

[0005] In accordance with a first aspect of the present invention there is provided a terminal multiplexer structure comprising a plurality of line interface cards and a plurality of trunk interface cards, wherein each of the line interface cards is connected to at least two of the trunk interface cards and comprises switching means for switching between the two trunk interface cards.

[0006] Accordingly, channel protection can be effected without the requirement for a separate switch rack disposed between the line interface cards and the trunk interface cards.

[0007] Preferably, the line interface cards and the trunk interface cards are configured as printed circuit boards capable of being inserted into slots of a rack of the multiplexer structure, and the connections between the line interface cards and the trunk interface cards are effected by way of backplane interconnects disposed on the backplane of the rack.

[0008] In one embodiment, the switching means comprises an electronic switch.

[0009] Advantageously, the line interface and the trunk interface cards are disposed in a manner such that each line interface card is connected to two adjacent trunk interface cards on either side of the line interface card, wherein each trunk interface card has a further trunk interface card on its other side.

[0010] In accordance with a second aspect of the present invention there is provided a terminal multiplexer structure comprising a plurality of line interface cards and a plurality of trunk interface cards, wherein each of the trunk interface cards is connected to at least two of the line interface cards and comprises switching means for switching between the two line interface cards.

[0011] Accordingly, line protection can be effected without the requirement for a separate switch rack disposed between the line interface cards and the trunk interface cards.

[0012] Preferably, the line interface cards and the trunk interface cards are configured as printed circuit boards capable of being inserted into slots of a rack of the multiplexer structure, and the connections between the line interface cards and the trunk interface cards are effected by way of backplane interconnects disposed on the backplane of the rack.

[0013] Advantageously, the line interface cards and the trunk interface cards are disposed in a manner such that each trunk interface card is connected to two adjacent line interface cards on either side of the trunk interface, wherein each line interface card has a further line interface card on its other side.

[0014] In one embodiment, the switching means comprises an electronic switch.

[0015] In accordance with a third aspect of the present invention there is provided a terminal multiplexer structure comprising a plurality of line interface cards and a plurality of trunk interface cards, wherein at least one of the line interface cards is connected to at least two of the trunk interface cards and comprises switching means for switching between the two trunk interface cards, and wherein at least one of the trunk interface cards is connected to at least two of the line interface cards and comprises switching means for switching between the two line interface cards.

[0016] Preferably, the line interface cards and the trunk interface cards are configured as printed circuit boards capable of being inserted into slots of a rack of the multiplexer structure, and the connections between the line interface cards and the trunk interface cards are effected by way of backplane interconnects disposed on the backplane of the rack.

[0017] In one embodiment, the switching means comprises an electronic switch.

[0018] In accordance with a fourth aspect of the present invention, there is provided a line interface card adapted, in use, to be connected to at least two trunk interface cards, the line interface card including switching means for switching the connection between the two trunk interface cards.

[0019] In accordance with a fifth aspect of the present invention, there is provided a trunk interface card adapted, in use, to be connected to at least two line interface cards, the trunk interface card including switching means for switching the connection between the two line interface cards.

[0020] Preferred forms of the present invention will now be described, by way of example only, with reference to the accompanying drawings.

## Brief description of the drawings

### [0021]

Figure 1 is a schematic diagram showing interface cards embodying the present invention.

Figure 2 is a schematic diagram illustrating a multiplexer structure embodying the present invention.

Figure 3 is a schematic diagram illustrating a multiplexer structure embodying the present invention.

## Detailed description of the embodiments

[0022] In Figure 1, a line interface card 12 is located between two trunk interface cards 10, 14.

[0023] Each of the cards 10, 12, 14 comprises an on-card electronic cross connect switch 16. The cross connect switches 16 are configured in a manner such that the respective interface cards can be selectively connected to either one of its neighbouring interface cards.

[0024] More particularly, in Figure 1 the centre line interface card 12 can be selectively connected either to the trunk interface card 10 or to the trunk interface card 14, by way of the cross connect switch 16 located on the line interface card 12.

[0025] Each cross connect switch 16 is controlled by an on-board controller 17 of the line or trunk interface cards 10, 12, 14, via an internal control channel 18. The controller 17 is itself controlled via signals received on serial connections ports 19, 19a, from two redundant communications controller cards (not shown) for fault tolerance.

[0026] In use, the on-card cross connect switch 16 thus enables a 1:1 protection against failure of one of the channels to which the respective trunk interface cards 10, 14 are connected. In other words, should eg the DWDM laser of the DWDM channel to which the trunk interface card 14 is connected fail, the cross connect switch 16 on the line interface card 12 will re-direct its front interface transceiver connectivity to the trunk interface card 10.

[0027] As shown in Figure 1, the cross connect switches 16 can alternatively be used to connect the respective cards 10, 12, 14 to two redundant external switch cards of a switch rack (not shown) via switch ports 21, 21a, should such a switch rack be provided.

[0028] It is noted that the interconnection between the cards 10, 12, 14 can be effected through backplane connections disposed on the backplane of a rack into which the cards 10, 12, 14 are, in use, inserted.

[0029] It will be appreciated by a person skilled in the art that similarly a trunk card 30 can be protected against failure of an associated line interface card by providing connectivity to two line interface cards 32, 34, wherein the trunk card 30 comprises a cross connect switch 36 to selectively connect the trunk card 30 to either of the

line interface cards 32, 34 (see figure 2).

[0030] Turning now to figure 3, a multiplexer structure 20 comprises two sets of alternately arranged front interface cards eg 22 and line interface cards eg 24. The multiplexer structure 20 can provide 1:1 protection switching without the need for a separate switch sub-rack.

[0031] It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

[0032] In the claims that follow and in the summary of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprising" is used in the sense of "including", ie features specified may be associated with further features in various embodiments of the invention.

## Claims

1. A terminal multiplexer structure comprising:

- a plurality of line interface cards and
- a plurality of trunk interface cards,

wherein each of the line interface cards is connected to at least two of the trunk interface cards and includes switching means for switching the connection between the two trunk interface cards.

2. A multiplexer structure as claimed in claim 1, wherein the line interface cards and the trunk interface cards are configured as printed circuit boards capable of being inserted into slots of a rack of the multiplexer structure, and the connections between the line interface cards and the trunk interface cards are effected by way of backplane interconnects disposed on the backplane of the rack.

3. A multiplexer structure as claimed in claims 1 or 2, wherein the line interface and the trunk interface cards are disposed in a manner such that each line interface card is connected to two adjacent trunk interface cards on either side of the line interface card.

4. A multiplexer structure as claimed in claim 3, wherein each trunk interface card has a further trunk interface card on its other side.

5. A multiplexer structure as claimed in any one of the preceding claims, wherein the switching means comprises an electronic switch.

6. A terminal multiplexer structure comprising:
- a plurality of line interface cards and
  - a plurality of trunk interface cards, 5
- wherein each of the trunk interface cards is connected to at least two of the line interface cards and including switching means for switching the connection between the two line interface cards. 10
7. A multiplexer structure as claimed in claim 6, wherein the line interface cards and the trunk interface cards are configured as printed circuit boards capable of being inserted into slots of a rack of the multiplexer structure, and the connections between the line interface cards and the trunk interface cards are effected by way of backplane interconnects disposed on the backplane of the rack. 15 20
8. A multiplexer structure as claimed in claims 6 or 7, wherein the line interface and the trunk interface cards are disposed in a manner such that each trunk interface card is connected to two adjacent line interface cards on either side of the trunk interface card. 25
9. A multiplexer structure as claimed in claim 8, wherein each line interface card has a further line interface card on its other side. 30
10. A multiplexer structure as claimed in any one of claims 6-9, wherein the switching means comprises an electronic switch. 35
11. A terminal multiplexer structure comprising:
- a plurality of line interface cards and
  - a plurality of trunk interface cards, 40
- wherein at least one of the line interface cards is connected to at least two of the trunk interface cards and comprises switching means for switching between the two trunk interface cards, and 45
- wherein at least one of the trunk interface cards is connected to at least two of the line interface cards and comprises switching means for switching between the two line interface cards. 50
12. A line interface card adapted, in use, to be connected to at least two trunk interface cards, the line interface card including switching means for switching the connection between the two trunk interface cards. 55
13. A trunk interface card adapted, in use, to be connected to at least two line interface cards, the trunk

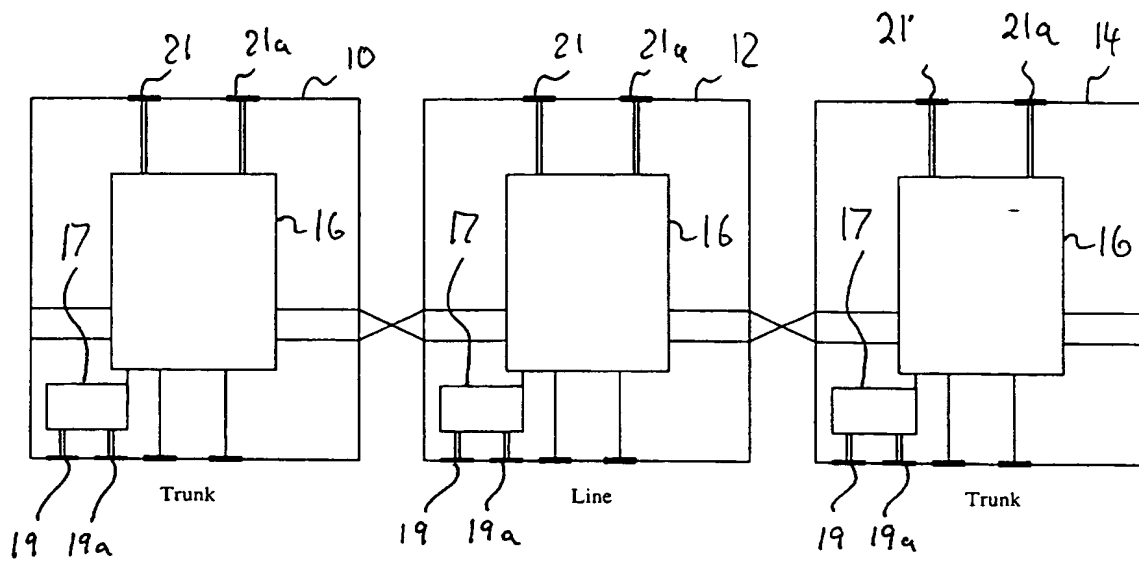


Figure 1

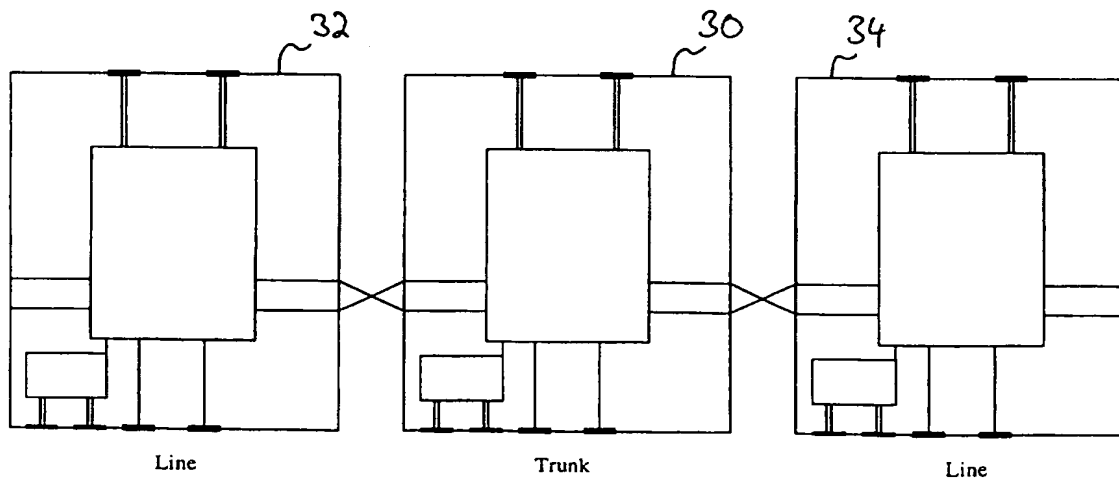


Figure 2

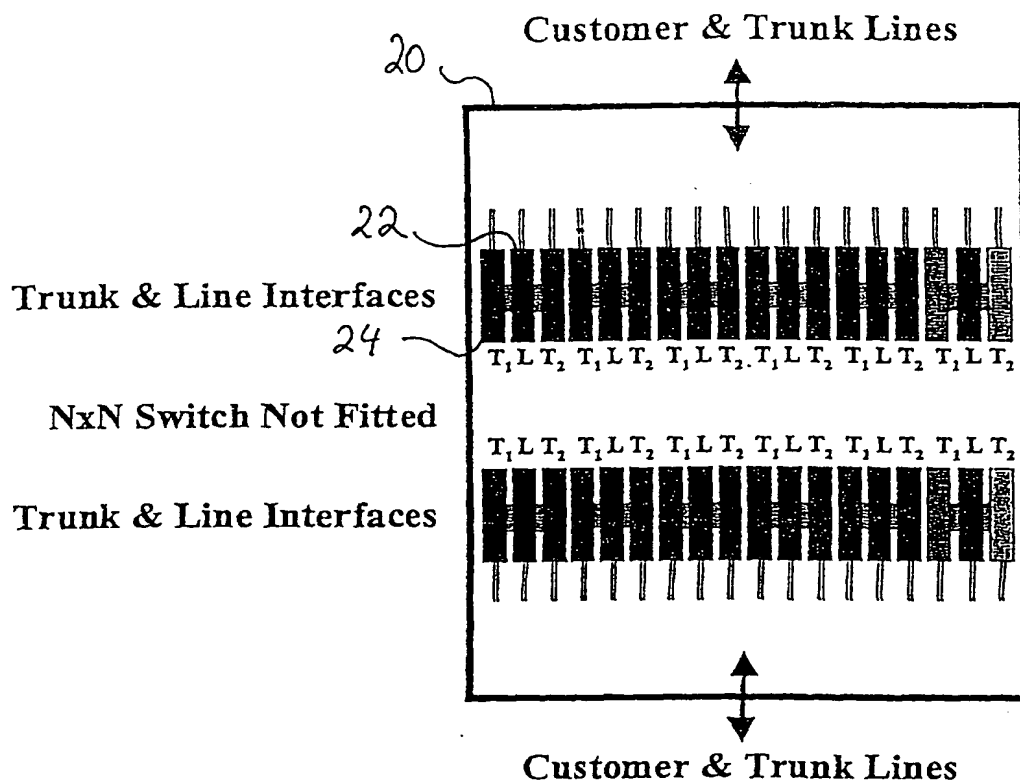


Figure 3



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## EUROPEAN SEARCH REPORT

Application Number  
EP 00 12 8448

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	GB 2 346 280 A (HEWLETT PACKARD CO) 2 August 2000 (2000-08-02)	1,3,4,6, 8,9, 11-13 2,7,10	H04Q1/02 H04J14/02
Y	* page 1, line 4 - page 2, line 17 * * page 2, line 26 - page 3, line 36 * * page 5, line 26 - page 7, line 33; figures 1-3 *		
X	EP 1 039 773 A (CIT ALCATEL) 27 September 2000 (2000-09-27)	1,3,5, 11-13 10	
Y	* column 1, line 3 - column 2, line 17 * * column 3, line 9 - line 30 * * column 3, line 48 - column 7, line 15; figures 1-3,10-14 *		
Y	WO 99 13656 A (KONINKL KPN NV ;DEVENTER MATTIJS OSKAR VAN (NL)) 18 March 1999 (1999-03-18)	2,7	
A	* page 1, line 2 - page 4, line 20 * * page 5, line 28 - page 9, line 1; figures 1,2 * * page 10, line 13 - page 14, line 10; figures.6-9 *	11-13	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H04Q H04J G02B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 22 June 2001	Examiner Roldán Andrade, J
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P4/C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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22-06-2001

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